CHICAGO SANITARY AND SHIP CANAL, LOCKPORT POWER HOUSE AND DAM
2502 Channel Drive
Lockport vicinity
Will County
Illinois

HAER IL-197-C
IL-197-C

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240-0001

HISTORIC AMERICAN ENGINEERING RECORD

CHICAGO SANITARY AND SHIP CANAL, LOCKPORT POWER HOUSE AND DAM

HAER No. IL-197-C

Location:	2502 Channel Drive, Lockport vicinity, Will County, Illinois UTM—Latitude: 41.569475; Longitude: -88.079579
Present Owner:	Metropolitan Water Reclamation District of Greater Chicago
Present Use:	The powerhouse still generates power. The dams have been significantly altered, and only one is operational.
Significance Statement:	The Lockport Power House and Dam were built as part of an extension to the Chicago Sanitary and Ship Canal after the Illinois State Legislature authorized the Sanitary District to develop a water power plant on the canal in 1903. The powerhouse is representative of typical powerhouse design and construction at the beginning of the twentieth century and contains machinery from the various periods of its operational history. The dams have been heavily modified from their original design.
Historian:	Justine Christianson, HAER, 2009
Project Information:	The Chicago Sanitary and Ship Canal Recording Project was undertaken during the summer of 2009 to record a portion of the canal. The project focused on 2.2-mile-long section between Illinois Waterway River Miles 291.1 to 293.3. The U.S. Army Corps of Engineers sponsored the project with research assistance and access provided by the Metropolitan Water Reclamation District of Greater Chicago. Special thanks to Philip W. Nieman of the Metropolitan Water Reclamation District of Greater Chicago for his comments on this report and the drawings. The field team consisted of Dana Lockett, HAER Architect and Project Leader; Nicole Martineau, HAER Intern, and Justine Christianson, HAER Historian. Jet Lowe, HAER Photographer, produced the large format photographs.

For additional information see:

Chicago Sanitary and Ship Canal	HAER No. IL-197
Chicago Sanitary and Ship Canal, Lockport Controlling Works	HAER No. IL-197-A
Chicago Sanitary and Ship Canal, Butterfly Dam	HAER No. IL-197-B
Chicago Sanitary and Ship Canal, Lockport Lock	HAER No. IL-197-D
Illinois Waterway, Lockport Lock, Dam and Power House	HAER No. IL-164-H

Part I. Historical Information

A. Physical History:

1. **Dates of Construction:** Construction of the powerhouse and installation of equipment took place from 1904 to 1908. In 1905, work began on the adjacent lock and dams, which were part of a separate contract.

2. **Architect/Engineer:** Isham Randolph, Chief Engineer of the Sanitary District, designed the powerhouse. When Randolph left the Sanitary District to serve on the Board of Consulting Engineers for the Panama Canal in 1905, G.M. Wisner of the Sanitary District took over as Acting Chief Engineer. L.K. Sherman served as Resident Engineer. Albert S. Crane, Hydraulic Engineer, designed the trash racks and gates at the wheel pit entrances. E.B. Ellicott was the Electrical Engineer.[1]

   E.L. Cooley, Assistant Engineer with the Sanitary District, designed the movable dams.[2]

   Builder/Contractor/Supplier: Hayes Brothers Company of Janesville, Wisconsin, built both the powerhouse and movable dams. Various contractors supplied the operating equipment for the powerhouse (more information can be found in Section B. Historical Context of this report). Chicago Bridge & Iron Company of Chicago supplied the steel work for the movable dams.[3]

3. **Original Plans:**
   Original construction drawings as well as descriptions of the construction process provide information on the original design and layout of the powerhouse, dams, and associated structures.

   Forebay
   The extant, reinforced-concrete fender wall extends diagonally from the eastern edge of the powerhouse to the west channel wall and creates a triangular forebay

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[1] "Power Plant of the Chicago Drainage Canal," *Engineering News* LV, no. 3 (January 18, 1906): 52-54.
[2] "The Movable Dams and Lock at the Power Plant on the Chicago Drainage Canal," *Engineering News* 60, no. 20 (November 12, 1908): 513.
[3] "Movable Dams and Lock at the Power Plant," 512-513; *Proceedings of the Board of Trustees of the Sanitary District of Chicago from January 11, 1906 to December 31, 1906* (Chicago: John F. Higgins, Printer, 1907), 11237, 11248, 11256.

Bidders for the construction of the powerhouse were all from Chicago and included: Falkenau Construction Company, Frank J. Cullen, Joseph Henreddy, Schillinger Brothers Company, Joseph J. Duffy, William Grace Company, B.M. Zadeck Company, Griffiths & McDermott, and Gindele Brothers & Company. See *Proceedings of the Board of Trustees of the Sanitary District of Chicago, January 1, 1905 to December 31, 1905* (Chicago: John F. Higgins Printer, 1906), 10489.

Bidders for the lock and dam construction contract included: M.H. McGovern of Chicago, Page & Shnable of Chicago, and Joseph J. Duffy Contracting Company of Lockport. See *Proceedings of the Board of Trustees of the Sanitary District*, 1906, 11237.

in front of the powerhouse and turbine intakes. The 525'-long wall is depicted with fourteen arches ranging from 19' to 25' (referred to as "submerged inlets") on a 1905 drawing.[4] A slightly earlier drawing shows the concrete fender wall reinforced with horizontal and vertical rods and having arches measuring 19' wide and separated by 6'-wide columns. According to this drawing, the top of the wall measured 6' wide.[5]

Powerhouse

The original plans of the powerhouse show a building that looks much as it does today.[6] The concrete powerhouse is depicted with a hipped roof clad in copper flashing, 10" Conosera red tiles, and a Conosera red tile ridge. The nearly identical east and west facades have multi-light, double-hung sash windows with multi-light, arched windows on top on the first level. Square patterned windows are located on the top floor. In addition, the east façade has twelve circular openings under the roofline where the power lines originally exited the building. Doors are centered on both the east and west facades. As originally planned, the south façade was divided into ten bays by 6'-wide pilasters with channeled joints that extended the full length of the wall and were topped by carved capitals. Each bay, except the last one on the east end, had three multi-light, double-hung sash windows measuring 11'-5 ½" tall x 6' wide on the first floor. Above these were three arched, multi-light windows topped by hood molds with carvings at the ends. Finally, each bay had a course of concrete blocks followed by three stationary, square patterned windows measuring 6' x 6' on the top floor. The last bay of the south façade had a double door on the first floor topped by a multi-light window. A railroad track running along the strip of land located to the east of the powerhouse extended to this door, allowing the shipment of machinery via railroad to the site. The penstock, topped by a concrete pad, is located on the north façade. Only the upper story of the north façade, which is punctuated by arched windows, was visible as a result.[7]

The interior of the powerhouse, as originally designed, was open from floor to ceiling with a 44' headroom clearance. Two mezzanines ran along the south

[4] Sanitary District of Chicago, Lockport Power Development, Power House, "General Location Plan," February 1905, Sheet No. 1, available from Metropolitan Water Reclamation District of Greater Chicago, Chicago, IL (hereafter cited as MWRD).

[5] Sanitary District of Chicago, Water Power Development, Canal Lock, Walls, and Movable Dams, "Fender Wall," December 1905, Sheet No. 20, available from MWRD.

[6] Differing dimensions of the building are given in various sources. "The Water Power Development of the Sanitary District of Chicago," November 12, 1914, 1774, gives the dimensions as 386' x 69', while *Engineering News* reported in 1905 the building would measure 142' x 390'. See "Water Power Development on the Chicago Drainage Canal," *Engineering News* LIII, no. 2 (January 12, 1905): 25.

[7] Sanitary District of Chicago, Lockport Power Development, Power House, "North, West and East Elevations," February 1905, Sheet No. 3; Sanitary District, Power House, "General Location Plan"; Sanitary District of Chicago, Lockport Power Development, Power House, "South Elevation," February 1905, Sheet No. unknown, all drawings available from MWRD. Photographs of the construction of the powerhouse are also available from the MWRD archives.

façade. The main level also housed office space at the east end and a machine shop in the southeast corner. Twenty-one transformers were located along the south façade of the main floor, which was referred to as the transformer gallery. The first level mezzanine held the main switchboard, along with outgoing line switches and vertical compartments. The bus bars connecting to the outgoing lines on the east end of the building ran along the second level mezzanine.[8]

On the north façade of the powerhouse were nine chambers, seven of which held turbines. The central chamber was divided into three 8'-wide chambers holding the exciters. The easternmost chamber was left open for later use. The chambers were approximately 32' wide and 79' long and divided by 6'-thick walls. Three miter gates spanned each chamber's entrance, and trash racks on structural steel supports acted as screens in front of the chambers to prevent debris from entering the chamber interiors.[9]

The area around the powerhouse was labeled in a 1906 drawing as the "yard." Another drawing indicates it was to be "backfilled with rock and broken stone, top dressed with 6" of broken stone and screenings." A set of stairs to the east of the powerhouse provided access to the top of the adjacent movable dams as well as the top of the penstock. In 1905-6, the stairway, equipped with iron hand railings, is shown with five risers, then a landing for a bridge crossing the tailrace of the 12' dam. This reinforced-concrete bridge spanning the tailrace was also equipped with a hand railing. The stairway then ascended fifteen more risers to a second landing, up another twenty risers to a third landing, and finally up another sixteen risers before reaching the top of the penstock and movable dams. The risers and treads were specified as being coated in "granolithic surface."[10]

Movable Dams

Two movable dams originally spanned the channel between the powerhouse and lock. It should be noted that the powerhouse itself served as the major portion of the dam, and the movable dams were simply auxiliary. The north wall of the powerhouse was 8' thick to fulfill its function of holding back 40' of water.[11] The easternmost dam measured 12' wide followed by a 48'-wide one. The dams were identical, aside from length. Each had gates constructed of radial frames clad in steel plates that resembled a 45-degree sector of a cylinder, much like a Tainter gate. They measured 52' in diameter and had a vertical range of 18' and a radius of 26'. The curved faces of the gates faced upstream and were hinged

[8] "Water Power Development of the Sanitary District," 1774-1774A.
[9] Sanitary District, Power House, "General Location Plan"; "Water Power Development of the Sanitary District," 1774-1774A; Isham Randolph, "Sanitary District of Chicago and the Chicago Drainage Canal: A Review of Twenty Years of Engineering Work," 1909, 8; Holland, Ackerman & Holland, Consulting Engineers, "Report on the Reconstruction of the Lockport Hydroelectric Plant," July 1, 1922, 27-28.
[10] Sanitary District of Chicago, Water Power Development, Canal Lock, Walls, and Movable Dams, "Movable Dams, General Plan," December 1905, revised January 1906, Sheet No. unknown, available from MWRD.
[11] Information provided by Phil Nieman, MWRD.

horizontally along the axis of the cylinder on a cast-iron wall plate at the top of the back dam chamber wall on the downstream side. This was opposite the standard direction "employed in earlier forms of the sector dams."[12] The hinge joint was watertight and equipped with 1-½" galvanized iron steam pipes to keep it from freezing. When the dams were raised, the decks were at a 45 degree angle, and when closed, they were horizontal. To keep the dams in the raised position, cast steel props were used; the 12' dam used one prop while the 48' dam used four at 12' intervals.[13]

The dam chambers had curved concrete breast walls. Culverts equipped with valves watered the chambers, and weir tubes helped regulate the water levels. Through plate-girder bridges over each dam allowed the operator to place a timber needle dam over the openings to cut off the flow of water in case of failure at the Controlling Works or Butterfly Dam further upstream or during repairs to the dams.[14]

A reinforced concrete abutment separated the two dams. A door on the bottom of the abutment's south façade (specified as oak veneer and standing 7' tall) gave operators access to the dam's operating machinery. The operating house sat on top of this abutment. The plans for this building give the dimensions as 12' wide x 26'-6" long. It was built of concrete block masonry, like the powerhouse, and had white pine framing and flooring. Also like the powerhouse, the hipped roof was clad in Conosera red tile. Bay windows with copper roofs and a set of double doors on the north façade punctuated the building's walls.[15]

The operating house covered the indicator, weir tube, and inlet pits located in the concrete abutment. The indicator pit contained four cast-iron float gauge wells as well as a ladder for access. The weir tube pit contained a cast-iron weir tube with counterweights suspended from chains that ran over pocketed chain wheels. A removable weir tube gear floor stand operated the weir tube gearing by controlling the position of the weir tube in the pit. The inlet pit was divided into three wells. The indicator and inlet pits had cast-iron floor plate covers, but the weir tube pit was open, although surrounded by posts and pipe railing.[16]

[12] "Movable Dams and Lock at the Power Plant," 513.
[13] "Movable Dams and Lock at the Power Plant," 513; "Movable Crest Dams at the Water Power Development of the Chicago Drainage Canal," *Engineering Record* 56, no. 8 (August 1907): 194; Sanitary District of Chicago, Water Power Development, Canal Lock, Walls and Movable Dams, "General Plan, Layout of Electrical Conduit," December 1906, Sheet No. 22, available from MWRD.
[14] "Movable Crest Dams at the Water Power Development," 195-196; "Movable Dams and Lock at the Power Plant," 513.
[15] Sanitary District of Chicago, Water Power Development, Canal Lock, Walls and Movable Dams, "Movable Dams-Operating House," December 1905, revised January 1906, Sheet No. 18, available from MWRD.
[16] Sanitary District of Chicago, Water Power Development, Canal Lock, Walls and Movable Dams, "Movable Dams, Operating Devices," February 1906, Sheet No. 15, available from MWRD.

4. **Alterations and Additions:**
A number of alterations have been made to the powerhouse (both the interior and the exterior) and the movable dams throughout their operational history.

Few alterations have been made to the exterior of the powerhouse. An addition was built at the north end of the east façade in the 1930s.

The greatest alterations have occurred to the operating machinery of the powerhouse. During the 1930s, major alterations were made to the operating equipment. A 1934 drawing shows the general arrangement of "Division B" turbines (each 220 hp) installed by James Leffel & Company of Springfield, Ohio.[17] These were DC exciters that replaced the original three exciters. During this same time period, units 1 and 2 were removed and replaced by two vertical shaft turbine generators with a capacity of 6 megawatts. During the mid-1930s, units 1 and 2 were removed and replaced by two vertical-shaft turbine generators with a capacity of 6 megawatts. In 1945, turbines 5 and 6 were replaced and reduced from six stages to four.[18]

During the 1960s, turbines 3, 4, and 7 were removed. In addition, the wood miter gates at the chamber entrances were removed and replaced by three vertical-lift sluice gates. These were used to release storm water as necessary. Around 1976-77, Turbine 5 was taken out of service, but left in situ along with its generator. Turbine 6 and its generator and Generator 7 remain, although they too are no longer in use. In the 1990s, transformer banks were built outside the powerhouse, and new 6,000-volt circuit breakers were also installed. The two turbines and generators at the west end of the powerhouse were again replaced ca. 2000 with vertical units.[19]

Major alterations were also made to the movable dams around 1986. A 20'-wide motorized vertical-lift sluice gate replaced the original 48'-wide dam. The remainder of the gate opening was filled in with concrete. The 12' dam was removed entirely, and the gate opening filled in with concrete as well.[20]

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[17] Sanitary District of Chicago, James Leffel & Co., "General Arrangement, Division 'B' Turbines (Each 220 hp), Lockport Plant," November 1934, Drawing No. 40039, available from MWRD.
[18] Information provided by Phil Nieman, MWRD.
[19] Branden K. Scott and Lowell Blikre, National Register of Historic Places Amended Multiple Property Submission and Nomination of the Chicago Sanitary and Ship Canal District to the Illinois Waterway Navigation System Facilities, May 21, 2009, Draft, Section 7, Page 16; Mary Yeater Rathburn and American Resources Group, Ltd., "Architectural and Engineering Resources of the Illinois Waterway between 130th Street in Chicago and La Grange," Volume II, prepared for U.S. Army Corps of Engineers, October 1996, 41; additional information provided by Phil Nieman, MWRD.
[20] Scott and Blikre, National Register of Historic Places Amended Multiple Property Submission and Nomination of the Chicago Sanitary and Ship Canal District, Section 7, Page 16.

B. Historical Context:
An Act of the General Assembly of Illinois provided for extending the Main Channel (otherwise known as the Chicago Sanitary and Ship Canal) and developing water power on the canal on July 14, 1903. This legislation authorized the Sanitary District to take advantage of the nearly 40' drop in elevation at Lockport and build a powerhouse there to generate power for its own use. In 1903, the Sanitary District embarked upon the Main Channel Extension, which extended the channel 2 miles from the Lockport Controlling Works to the Lockport Power House, Dams, and Lock. (The total length of the extension including the tailrace was approximately 4 miles.) The development of water power on the canal required the construction of a number of structures at the canal's terminus, including the fender wall, the powerhouse itself, movable dams, and tailrace.[21]

Forebay and Fender Wall
The arched fender wall, built as part of the lock and dam contract, created a triangular forebay in front of the powerhouse. The fender wall diverted ice and other debris from the forebay, instead sending it to the 48' dam where it could be passed downstream.[22]

Movable Dams
The Main Channel Extension involved construction of movable dams adjacent to the powerhouse, which were necessary for a variety of reasons. The dams regulated the flow of water through the channel and the level of water in the forebay, as well as providing an outlet for ice and debris, like driftwood, that collected in the forebay. The 12' dam, located closest to the powerhouse, was specifically used to discharge the material raked away from the turbine intakes.[23]

The two dams were included in the contract for the construction of the fender wall and lock. The Sanitary District advertised the contract in August 1905 and received several bids. Hayes Brothers & Company of Janesville, Wisconsin, won the contract with an estimated cost of completion of $318,335.[24]

The Sanitary District specified that the 12' dam would be located 45' from the upstream corner of the powerhouse. A 12'-wide concrete pier would separate this dam from the 48' dam. The pier contained the operating machinery. On top of the pier was a concrete block operating house designed in a similar style as the powerhouse. A 24'-long cross wall separated the dams from the adjacent Sanitary District's Lockport Lock.[25] The 12' dam had a 12'-wide tailrace, and the 48' dam had a 575'-long tailrace. Both of these connected to the powerhouse's tailrace and were carefully engineered. According to a

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[21] "Water Power Development of the Sanitary District of Chicago," 1771.
[22] Information provided by Phil Nieman, MWRD.
[23] "Movable Dams and Lock at the Power Plant," 512; The Sanitary District of Chicago, "Engineering Data on the Sanitary District of Chicago," (June 1910), 7; "Movable Crest Dams at the Water Power Development," 194.
[24] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1905, 10727-28; *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1906, 11237, 11248, 11256. The other bidders included M.H. McGovern of Chicago, Page & Shnable of Chicago, Joseph J. Duffy Contracting Company of Lockport.
[25] "Movable Crest Dams at the Water Power Development," 194.

1907 article in the *Engineering Record*, the Sanitary District had learned from construction at the Controlling Works that the velocity of the water being discharged from the dam had to be gradually reduced to prevent erosion and the formation of dangerous currents and eddies. In order to accomplish this, the larger dam's tailrace gradually widened and deepened before the water passed over a low weir and entered the powerhouse's tailrace.[26] In the first 110' of the tailrace, it increased to a 54' width, while the concrete bottom gradually sloped away as well. At the end of this 110' section, the tailrace dropped 11' in depth over the course of a 10' distance to create a 55' x 75' pool. A second pool measuring 55' x 60' with 3' less water than the previous pool followed. Finally the water flowed into a channel that was 3' shallower than the second pool and over a low weir before discharging into the powerhouse's tailrace.[27]

Powerhouse
In August 1902, the Sanitary District advertised a call for "proposals for constructing certain works for the conservation of water power on the Channel of the Sanitary District of Chicago and the Desplaines River."[28] The work at Lockport would consist of excavating the channel, preparing wall foundations, building concrete retaining walls, and completing other auxiliary work.[29] The result of this call for proposals is not known, but nearly two years later, the Sanitary District finally began construction of the powerhouse. The work was divided into separate contracts covering construction of the powerhouse, as well as supplying and installing the operating equipment.

In June 1904, the Sanitary District advertised a contract to supply the turbine water wheels and governors for the power plant. The contract specified four "power units" at 6,400 horsepower (hp) each and three "exciter units" of 600 hp at a 34' head. Each turbine would have an accompanying governor to control the speed of the water wheels.[30] In response to the advertisement, the board received four bids and awarded the contract to Wellman-Seaver-Morgan Company of Cleveland, Ohio, who had bid $91,230.[31]

The power units consisted of 54" Jolly-McCormick turbine wheels or runners. Each wheel would have a gate and all of them would be controlled by a governor, specified as Lombard, type N. The water would discharge from the gates into draft tubes. Further specifications provided in the contract stated that the turbine and gate design supplied by the contractor should be capable of discharging 100,000 cubic feet of water/minute when

[26] "Movable Crest Dams at the Water Power Development," 196; "Movable Dams and Lock at the Power Plant," 512-513.
[27] "Movable Crest Dams at the Water Power Development,"196.
[28] *Proceedings of the Board of Trustees of the Sanitary District of Chicago from January 1, 1902 to December 31, 1902* (Chicago: John F. Higgins, Printer, 1903), 8039.
[29] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1902, 8040.
[30] *Proceedings of the Board of Trustees of the Sanitary District of Chicago from January 1, 1904 to December 31, 1904* (Chicago: John F. Higgins, Printer, 1905), 10196. Phil Nieman points out that the generators installed were rated at 5,362 hp.
[31] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1904, 10026, 10162, 10189-90. Other bidders included S. Morgan Smith Company of York, Pennsylvania; Allis-Chalmers Company of Chicago, Illinois; and The Stilwell-Bierce and Smith-Vaile Company of Dayton, Ohio.

operated at a .8 gate, meaning "the point of gate opening at which eight-tenths of the ultimate discharge of the wheel is made." The power units would be capable of generating 5,092 hp at 165 rpm, while the exciters would reportedly generate 632 hp at 300 rpm. The exciter units would each be equipped with two 30" Jolly-McCormick turbines that would discharge via a draft tube in the penstock floor.[32]

In December 1904, the board advertised for proposals to supply and install the alternating current and exciter generators.[33] Crocker-Wheeler Company won the contract in March with a bid of $101,366.[34] The contract specified that the generators would be the water wheel type and be directly connected to the horizontal shafts of the hydraulic turbines. The alternating current generators had the following specifications: 4,000 kilowatt, 6,600 volt, three-phase, sixty-cycle, and 164 rpm. The specifications for the exciter generators were: 350-kilowatt, 250-volt, 300 rpm, Multipolar Direct-Current Compound-Wound Generators. These would furnish the exciting current to the 4,000-kilowatt generators.[35]

The Sanitary District authorized the advertisement to build the powerhouse in February 1905. The contract called for construction of a 160'-wide x 386'-long x 100'-tall concrete building with nine turbine chambers designed for a working head of 34'. The building would also contain a generator room measuring 62' x 359' and offices at 20' x 62'.[36] The Sanitary District awarded the contract to the Hayes Brothers Company, who had bid $172,357.[37] A side track would be laid to the powerhouse to facilitate the delivery of machinery. In addition, contractors would be able to use a 40-ton electric crane running the length of the building.[38]

The various contract specifications developed by the Sanitary District provide invaluable information as to the design and construction of the powerhouse. The building would have a roof built of long leaf Southern yellow pine purlins and sheathed in Southern yellow pine. The Sanitary District specified cladding the roof in a tile like Conosera tile, which was manufactured by the Celadon Roofing Tile Company of New York and Chicago. The powerhouse's side walls and partitions would be built of Chicago Concrete blocks, which were hollow and similar to those blocks made by the American Hydraulic Stone Company. Cement blocks would form the exposed surface of the walls. The window frames and sashes were to be similar to the J.C. McFarland & Company's

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[32] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1904, 10196, 10201-10203.
[33] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1904, 10310-11.
[34] Bidders included the National Electric Company of Milwaukee, Westinghouse Electric and Manufacturing Company of Pittsburgh, Crocker-Wheeler Company of Chicago, General Electric Company of Chicago, Stanley GI Electric Manufacturing Company of Pittsfield, Massachusetts, and The Bullock Electric Manufacturing Company of Chicago. See *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1905, 10380, 10417.
[35] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1905, 10420-21.
[36] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1905, 10373.
[37] Other bidders, all from Chicago, included: Falkeanau Construction Company, Frank J. Cullen, Joseph Henreddy, Schillinger Brothers Company, Joseph J. Duffy, William Grace Company, B.M. Zadeck Company, Griffiths & McDermott, and Gindele Brothers & Company. See *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1905, 10489, 10500.
[38] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1905, 10420.

Fireproof Windows, and the hardware would come from P&F Corbin's Catalogue. The windows and doors would have AA No. 1 American beveled plate glass glazing. Door frames and transoms would be built from sawed red oak. The double doors at the track entrance would be built of white pine with strap iron hinges and a cast-iron frame. The other doors in the building would be veneered, quarter sawed red oak with a white pine core.[39]

The powerhouse interior was open from floor to ceiling, aside from two mezzanines located along the southern wall. Interior finishes consisted of white enamel brick applied to the bulkheads and chambers. The Sanitary District specified that enamel bricks like the No. 1 Norman Flat stretchers manufactured by the Tiffany Enameled Brick Company be used. Galvanized steel ties would anchor the bricks every foot. A wall clad in the white enameled brick would separate the transformers from the generator room on the first floor. The office and store room, located along the west end of the building, would be finished with lath and plaster and the white enamel bricks. A white tile floor would be laid in those spaces, while the rest of the flooring on the first level would be concrete. A lavatory equipped with urinals, water closets, and stalls built of Wolff's F5412 Italian marble were also included in the specifications.[40]

Six 15" 42-pound I-beams supported the second level mezzanine, which had a 6"-thick Portland cement concrete floor. The third level mezzanine, supported by six 12" 31.5-pound I-beams had a 5"-thick floor. The Sanitary District specified that the floors be reinforced with expanded metal rods to create a 150-pound-per-square-foot carrying capacity on the second balcony and a 100-pound-per-square-foot carrying capacity on the third floor. The floors would have a granolithic finish.[41]

The powerhouse contract also provided the specifications for the nine turbine chambers. At the entrances to the chambers were trash racks that prevented debris from entering and potentially damaging the equipment. The upper ends of the racks hooked "over a narrow-gauge track, which is laid on this platform and extends the length of the rack." The trash collected on the racks could then be pulled up into cars running on the tracks to the 12' dam where the debris could be disposed.[42] Each chamber had three sets of miter gates across its opening. The gates were specified as being built of 9' x 12' "first quality" yellow pine timber, aside from the top six courses, which would be first quality white oak.[43] The three exciter wheel chambers would be equipped with pivoted gates at the openings.[44]

[39] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1905, 10515-24.
[40] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1905, 10520-23; *Proceedings of the Board of Trustees of the Sanitary District of Chicago from January 1, 1907 to December 31, 1907* (Chicago: Fred Klein Co., Printers, 1908), 288, 551.
[41] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1905, 10525.
[42] "Movable Crest Dams at the Water Power Development," 194.
[43] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1905, 10524-25.
[44] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1905, 10525.

The equipment used in the powerhouse was part of a separate contract that was also broken into divisions. The Sanitary District received bids in October 1905 and awarded each division of the contract separately.[45] The Division A contract covered the main switchboard and instruments, as well as the series and potential transformers. It was awarded to Stanley GI Electric Manufacturing Company of Pittsfield, Massachusetts. The company also won the Division C contract for the generators' rheostats.[46] The Division B contract included the transfer boards along with the oil, circuit breaker, and knife switches. It was awarded to Arthur Frantzen Company, who also won the Division D contract for the bus bars and circuit compartments.[47] The Sanitary District awarded Brennan Electric Construction Company the Division E contract covering the conduits, generator and transformer connections, and service wiring, and the Division J contract to erect the copper and aluminum conductors.[48] The Division F contract for the transformers and lightning arresters went to General Electric, while Western Electric won the Division I contract to supply aluminum conductors.[49] Division K covered the high tension insulators and went to Porter & Berg.[50] Finally, the Sanitary District awarded the Division L contract for the traveling crane to the Whiting Foundry Equipment Company.[51]

In March 1907, the Sanitary District advertised another contract split into divisions for the powerhouse equipment. This time, the contracts encompassed supplying and installing the alternating current generator, turbine water wheel unit, switchboards, transformers, and wiring.[52] Division A covered the installation of the alternating current and rheostat and went to Crocker-Wheeler Electric Company.[53] General Electric Company won the Division B contract to install the switchboard panels and oil circuit breaker switches, as well as the Division D contract for the hydro-electric power unit.[54] The generator and transformer connections were included in Division C and awarded to

[45] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1905, 10848 and 10870. Companies bidding included Manning, Maxwell and Moore, Inc. of Chicago; The Wellman-Seaver-Morgan Company of Cleveland, Ohio; Chicago Edison Company of Chicago; The Case Manufacturing Company of Columbus, Ohio; Niles-Bement-Pond Company of Chicago; Whiting Foundry Equipment Company of Harvey, Illinois; Westinghouse Electric and Manufacturing Company of Pittsburgh; Crocker-Wheeler Company of Ampere, New Jersey; Aermotor Company of Chicago; Pawling & Harnischfeger of Milwaukee; Northern Engineering Works of Detroit; General Electric of Chicago; Porter & Berg of Chicago; Challenge Company of Batavia, Illinois; Brennan Electric Construction Company of Chicago; American Insulated Wire & Cable Company of Chicago; The Franklin Rolling Mill and Foundry Company of Franklin, Pennsylvania; American Electrical Works of Providence, Rhode Island; Stanley GI Electric Manufacturing Company of Pittsfield, Massachusetts; W.R. Garton Company of Chicago; Standard Underground Cable Company of Pittsburgh; Arthur Frantzen Company of Chicago; John A. Roebling's Sons Company of Chicago; Western Electric Company of Chicago; and The Pittsburgh Reduction Company of Pittsburgh.
[46] The company's bid for Division A was $3,546 and $1,515 for Division C.
[47] The company's bid for Division B was $13,836 and $8,629 for Division D.
[48] Brennan Electric Construction Company bid $6,285.87 for Division E and $4,357.80 for Division J.
[49] General Electric bid $74,888 for Division F, and Western Electric bid $423 for Division I.
[50] Porter & Berg's winning bid was $5,920.
[51] Whiting Foundry Equipment Company bid $5,800.
[52] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1907, 224.
[53] The estimated cost of the Division A work was $26,097.
[54] General Electric bid $9,789 for Division B and $22,932 for Division D.

W.A. Jackson.[55] Finally, the Sanitary District awarded the Division E contract for the turbine water wheel unit to S. Morgan Smith Company.[56]

A few months later, in July, the Sanitary District advertised for the furnishing and installing of oil circuit breakers, lightning arresters, a switchboard panel, transformer and switch connections, ground wire, and cast-iron covers and steel frames.[57] As with the other powerhouse contracts, these were also separated into divisions and awarded to the company with the lowest bid. Division B included the lightning arresters and was awarded to Arthur Frantzen Company. They also won the Division D contract for supplying the transformers and switch connections.[58] The installation of the switchboard panel, part of Division C, was awarded to General Electric Company.[59] Finally, William F. Klemp supplied and installed the cast-iron covers and steel frames that were part of Division F.[60]

By November 1907, the construction of the powerhouse and the installation of equipment had been completed. The completed Lockport Powerhouse is typical of early-twentieth-century powerhouse design and construction. On November 26, the Sanitary District turned on the power after completing extensive testing. The *Chicago Daily Tribune* reported the generated power "will be delivered by means of aluminum cables to Chicago, the town of Cicero, the west park board, and the village of Morgan Park." The use of aluminum rather than copper transmission lines was touted as being used "practically for the first time east of the Mississippi" and declared to be the "finest of its kind in the world."[61]

The majority of the power produced at Lockport was stepped up and transmitted nearly 30 miles to a terminal station at Western Avenue, where the power was stepped down and distributed. The main transmission lines ran along the canal's right-of-way and were carried on "nests of four Lock insulators" that each measured 12" high and 14" in diameter. The 50' galvanized steel poles carrying the lines were spaced 350' apart and had cross arms, the lowest one measuring 18' long and the highest 12' long. The poles measured 42" at the base and 20" at the top and sat on a concrete base extending 6' into the ground.[62]

In the 1920s, the Sanitary District considered replacing one or more of the "obsolete" power turbine units with vertical shaft, single runner turbines and had Holland, Ackerman & Holland, Consulting Engineers, produce plans in 1922, which were published in a report to the Sanitary District. Holland, Ackerman & Holland proposed making a

[55] Their winning bid was for $2,600.
[56] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1907, 418, 550.
[57] *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 1907, 581.
[58] The company's bid was $395 for Division B work and $2,585 for Division D work.
[59] General Electric's winning bid totaled $2,775.
[60] Klemp's bid estimated the work at $1,575.
[61] "Canal Power is Turned On," *Chicago Daily Tribune*, November 27, 1907, 2.
[62] The specifications required that the wires be made of nineteen strands. "Water Power Development of the Sanitary District of Chicago," 1727, 1778.

number of changes to the powerhouse's equipment. The proposed new power units would consist of a vertical shaft, direct connected, single runner hydraulic turbine and an alternating current generator. The turbine gates would have a lenticular shape, and the gate operating mechanism would be housed outside the turbine casing. The units would be controlled by an oil pressure governor with remote electrical control connections to the switchboard. Individual motor-driven oil pumps or duplicate oil pressure lines would supply the oil for the governors. The proposal also included replacing the switchboard with a "modern bench board with new instruments, with a relocation possibly at a higher level and the enclosure of the switchboard room in a glass partition to provide more suitable operating quarters."[63] The current location of the switchboard seems to indicate the Sanitary District followed this recommendation. In addition, the report recommended redesigning the trash racks to have a greater distance between the bars. The original racks caught too much material, which slowed the water flow into the wheelpit.[64]

Despite the report produced by Holland, Ackerman & Holland in 1920, it was not until 1936 that the Sanitary District contracted E.J. Albrecht Company, S. Morgan Company, and Allis Chalmers to install new power units. The *Chicago Daily Tribune* noted that two new units were installed in 1936.[65]

The 1930 Supreme Court ruling reducing the allowable water diversion from Lake Michigan from 5,000 cubic feet/second (cfs) to 1,500 cfs resulted in a decrease in the amount of power produced by the powerhouse. As reported by the *Chicago Daily Tribune*, the powerhouse had produced 140 million kilowatt hours in 1938, but in 1939, that number had dropped by half to 70 million with a corresponding reduction in revenue from $700,000 to $350,000. The 140 million kilowatt hours had not been sufficient to supply the two principle recipients of the power, the "park district" and the city of Chicago, reported the paper.[66]

The installation of nine sluice gates to replace some of the wood miter gates at the turbine chamber entrances in 1959 at a cost of $400,000 was cause for concern among some Joliet officials who feared that the Des Plaines River would rise and flooding would occur. The U.S. Army Corps of Engineers and the Sanitary District, on the other hand, argued that the gates would allow better flow regulation. In addition, the sluice gates would allow the District to discharge nearly twice as much storm water from the area as had occurred during floods in 1954 and 1957 since the minimum discharge capability would be 43,000 cfs.[67]

The Metropolitan Water Reclamation District of Greater Chicago, as the Sanitary District is now known, continues operating the Lockport Power House and generating power using two power units installed around 2000. It produces 34,500 kilovolts and is now

[63] Holland, Ackerman & Holland, "Report on the Reconstruction of the Lockport Hydroelectric Plant," 30.
[64] Holland, Ackerman & Holland, "Report on the Reconstruction of the Lockport Hydroelectric Plant," 28-30.
[65] "Lockport Power Halved by Slash in Lake Diversion," *Chicago Daily Tribune*, March 27, 1939, 6.
[66] "Lockport Power Halved," 6.
[67] "Sluice Gates Won't Change River Level," *Chicago Daily Tribune*, May 28, 1959, S2.

controlled remotely from the district's headquarters in Chicago. A variety of equipment and machinery remains in the powerhouse.

Part II. Structural/Design Information

A. General Description:[68]

Tailrace, Guide and Fender Walls

To the north of the powerhouse and extending in a westerly direction to create the forebay is a concrete fender wall. A portion of the fender wall, topped by iron railings, is visible above the water line. The fender wall still diverts debris from the forebay to the site of the original movable dams, where it can be removed and disposed of in a landfill.[69] The forebay supplies water to the powerhouse.

To the west and south of the powerhouse is a concrete guide wall that extends from the movable dam and curves to the south, directing water from the dam into the powerhouse's tailrace.

A roughly triangular piece of land separates the tailraces of the movable dams and powerhouse. The point of the triangle is located downstream. On the west side of this piece of land (known as the yard) are the former railroad tracks leading into the powerhouse. A spalling concrete sidewalk and concrete wall run along the east perimeter.

Movable Dams

To the east of the powerhouse are the movable dams. A flight of concrete stairs with pipe railings and a set of metal stairs with pipe railings are located next to the powerhouse and provide access from the powerhouse yard to the top of the movable dams and the concrete slab covering the turbine chambers. The metal stairs are in the location of what was the 12' dam, which has been removed and closed in with concrete, although some of the original metalwork is still visible. Next is a concrete abutment, on top of which sits the dam operating house. It resembles the powerhouse in style and is built of the same materials. The dam operating house is built of concrete blocks with a narrow band of mortar to simulate stonework and has a hipped roof clad in red clay tile. Decorative details include a cornice with egg-and-dart and dentil moldings. The east and west facades have cant bay windows covered by copper roofs that would have provided the operator with a clear view of the movable dams. The window openings are now filled in with glass blocks. On the other side of the dam operating house is a guide wall and then the larger movable dam, which has also been altered. The original gate has been removed and replaced with a smaller, vertical-lift gate, with the remaining space filled in by concrete. An operating bridge spans the length of the dam. Another set of concrete stairs featuring arched supports and pipe railings sits on the east guide wall of the dam

[68] The description of current conditions is based on a site visit made by the HAER recording team in summer 2009.
[69] Information from Phil Nieman, MWRD.

and separates the dam from the adjacent lock. The east guide wall is equipped with a pipe railing.

Powerhouse, Exterior
The powerhouse is located in the west half of the Chicago Sanitary and Ship Canal and accessed by a gravel road that runs along the west bank of the canal. To the north of the powerhouse is the forebay, which stores water for the powerhouse. The turbine chambers are located on the north façade, with the screen racks and gates across the turbine chamber entrances. Once water passes through the turbines, it exits the chambers through draft tubes that flow under the powerhouse and discharge into the powerhouse's tailrace.

The powerhouse is built of concrete blocks with a narrow band of mortar that simulates stonework. In addition, there are numerous decorative concrete details on the powerhouse exterior, including a cornice featuring egg-and-dart and dentil molding. The incorporation of these architectural details reveals the Sanitary District's concern with building a monumental and decorative powerhouse. A 1911 manual notes that this was not always the case: "it is to be deplored that little if any thought is generally bestowed upon the architectural appearance of the power-house superstructure; as a rule, it is of the character of the plainest factory structure."[70] The hipped roof is clad in red clay tiles with three monitors at the ridge. A 1923 publication on powerhouse design notes that "roofs covered with red tile are often used and present a very pleasing appearance," so it is not surprising the Sanitary District chose to use that roofing material.[71]

Pilasters with Greek Ionic order capitals divide the symmetrical south façade into ten bays. The nine bays stretching from west to east have arcades of three full-length windows extending from the first to the second floors between the pilasters. Each arcade consists of three eighteen-light windows topped by a course of concrete blocks and then arched windows topped by a decorative hood mold. Arched windows were often used in powerhouses. The third floor has three square windows with patterned panes. A steel frame with a gate is located at the west end of the south façade and serves as a stop log for the draft tubes of the new power units. A double wood door at the easternmost bay interrupts the symmetry of the façade. Over each door are nine-light windows. The double doors allowed machinery to be delivered to the powerhouse via a railroad track, which was also a common feature of powerhouses.[72]

The east façade has pilasters at each corner. Between the pilasters is an arcade of windows extending from the first to second floors. The arcade is made up of two double-hung sash windows followed by a set of double doors and then another two double-hung sash windows topped by a set of three lights with patterned panes. Four of the first floor

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[70] H.A.E.C. von Schon, *Hydro-Electric Practice: A Practical Manual of the Development of Water Power, Its Conversion to Electric Energy, and Its Distant Transmission*, 2d ed. (Philadelphia: J.B. Lippincott Co., 1911), 234.
[71] David Rushmore and Eric Lof, *Hydro-Electric Power Stations*, 2d ed. (New York: John Wiley & Sons, Inc., 1923), 162.
[72] Rushmore and Lof, 162-163.

double-hung sash windows have been altered by the insertion of window air conditioners. A course of concrete blocks separates these windows and set of doors from five arched windows topped by a decorative hood mold. The third floor has five square windows with patterned panes. Extending to the north of the main structure is a concrete, one-story addition with various windows, some of which have been filled in with concrete. The roof of this addition is nearly flat.

A projection at the north façade holds the turbine chambers and is covered by a concrete slab so that only the top floor of the north façade is visible. That portion of the north façade that is visible is punctuated by arched windows, but there is no other ornamental detailing. The concrete slab covering the turbine chambers has inspection tubes providing access to the chambers as well as recesses housing the various pieces of operating machinery. A one-story projection at the east half of the addition extends north and has a flat roof. It is labeled on a 1983 drawing as a "storage shed."[73] Twelve-light casement windows with lintels punctuate the addition's walls.

The west façade of the powerhouse is identical to that of the east, although the two northern window openings have been concreted closed and a doorway covered by an awning is centered on this façade. A one-story, concrete block addition is located at the northwest corner with access provided by a door covered by an awning on the south façade. A set of concrete stairs with one turn and equipped with pipe railings is located at the northwest corner of the powerhouse and allows access from the penstock at the north façade to the bottom level of the powerhouse.

Powerhouse, Interior
The interior is a clear span with an exposed roof truss system and two mezzanines running along the south side of the building that are accessed by spiral staircases. The interior division of space is typical of the period, as powerhouses were generally divided into two bays. The front bay contained the turbines and generators while the rear housed the transformers and switching apparatus and was separated from the front bay by a wall or row of support columns. In addition, the rear bay often housed two or more floors and was often divided into rooms while the main bay was left open to allow room for operating and repairing the machinery as necessary.[74] The interior finishes of this powerhouse consist of concrete floors and white-glazed brick cladding about three-quarters of the walls. This was typical of "more important stations" according to one period book, which also recommended keeping the interior walls light by applying a smooth plaster surface and whitewash or paint.[75] Tie rods connect the bricks to the concrete walls at random intervals. The remainder of the walls is exposed concrete blocks. A crane runs the length of the building on rollers and is marked "Whiting Foundry Equipment Company, Harvey ILL USA, Chicago suburb, capacity 80,000

[73] The Metropolitan Sanitary District of Greater Chicago, Lockport Powerhouse, Contract 83-656-11, "Repair of Draft Tubes, Location Plan, Draft Tubes Section and Core Drilling," May 1983, Sheet No. S-1, available from MWRD.
[74] Rushmore and Lof, 157; von Schon, 47.
[75] Rushmore and Lof, 162.

pounds." It is original to the building. Provision of a traveling crane along the length of the powerhouse was another typical design feature.[76]

The Lockport Power House contains a variety of equipment and operating machinery dating to various points in the plant's operational history. The first floor holds the turbines and generators, exciters, transformers, distribution bus room, panels and switches, machine shop, and offices. The openings to the turbine chambers are ranged along the north wall of the powerhouse. As was typical, the generators sit on a concrete pad in a line paralleling the long axis of the powerhouse. Periodic sets of stairs provide access, and pipe railings are located at the edge of the slab as protection against the drop off. There are eight turbine chambers (nine chambers total including the exciters), although the easternmost one has never been used and remains empty. The two westernmost turbines and generators were installed in 2000 and replaced two dating from a 1930s-era Works Progress Administration project. These two are vertical, so the shafts extend vertically from the generators to the turbine runners (propellers), which are located in scroll chambers. These turbines each have sixteen wicket gates and propellers at the ends of the shafts. The scroll chamber is normally filled with water, but stoplogs can be dropped into place, cutting off the flow of water into the chamber. The chamber is accessed by a manhole and 20' ladder.[77] Two controls are used to operate the turbines: one changes the pitch of the runner blades while the other changes the positions of the wicket gates (they operate at the same time). These two power units are the only ones still in operation and generate 9,000 horsepower.

To the east of these two modern generators and turbines are two empty chambers. Next are two exciters that are no longer in use but date to 1934. Exciters were usually placed at the center of the line of generating units in powerhouse design.[78]

To the east of the exciters are three Crocker-Wheeler generators. A plate on the generator reads: "Crocker-Wheeler Company, Ampere NJ, No. 112, 480.S.44, 4000 kva, 163.5 rpm, 60, 6600 volts, 350 amperes." The ninth chamber and pit at the eastern end of the building were built but never equipped.

The turbine chambers are vast arched spaces with 6'-thick concrete walls. Holes in the chamber ceilings accommodated tubes for operators to inspect the turbines. The gates to the chambers differ. The two westernmost bays are open, while bays 3, 4, and 7 have three 9' x 14' sluice gates operated by a motor. Bay 6 retains the original configuration of three sets of wood miter gates. The center bay, for the exciters, had three butterfly gates that were operated by hand, while Bay 5 has been closed by a steel bulkhead. During the summer of 2009, the gates were closed and the chambers filled with concrete. Bay 8 was never put into use.[79]

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[76] Duncan Hay, "Hydroelectric Development in the United States, 1880-1940," prepared for Edison Electric Institute, Washington, DC, 1987, 106; Rushmore and Lof, 163.
[77] Information provided by Phil Nieman, MWRD.
[78] Rushmore and Lof, 168.
[79] Rathburn, 41; information provided by Phil Nieman, MWRD.

Along the east end of the building is office and storage space, as well as a kitchen. These rooms have been reconfigured, but original finishes, like the wood molding and the exterior doors, remain.

The south half of the building contains a variety of equipment serving different functions and is separated from the turbines and generators by walls clad in white glazed brick. Dividing the turbines and generators from the transformers and other equipment on the main floor by a wall was a common layout in early-twentieth-century powerhouses. At the southeast end is the machine shop equipped with belt-driven machinery.[80] Other equipment includes two of the original transformers, which originally totaled twenty-one in number (three transformers per chamber). Manufactured by General Electric of Schenectady, New York, the Number 640059, Type WC transformers have coiled copper tubes sitting in oil. The transformers stepped up the 6,000 volts produced by the generators to 34,000 volts. At the southwest corner of the main floor is the cooling water skid. The powerhouse uses canal water, which is pumped to a heat exchanger where it is used to cool a mix. This mixture is then pumped to the heat exchanger in the bearing oil reservoir where it cools the oil. There are also various control panels and switches to operate the exciters, sluice gates, and generators. Two compressed air tanks remain that were once used to operate the governors.[81]

Mezzanines constructed of riveted steel I-beams and concrete poured in a series of arches extend along the south wall of the building. Steel beams also serve as vertical supports. The second-level mezzanine contains the enclosed switchboard room, which overlooks the turbines and generators. This was the typical location of the switchboard in powerhouses built in the early twentieth century. Windows in the switchboard room provided the operator with clear views of the generators and exciters below. The switchboard, equipped with Westinghouse controls, is located on the north wall of the room. The modern control center equipped with computers and display screens is located at the southwest corner of the second level mezzanine. The powerhouse is now controlled remotely from the Metropolitan Water Reclamation District's Chicago office. The 34-kilovolt circuit breakers, head and tailrace elevation gauges, a toilet room equipped with a chemical toilet, and storage space can also be found on the second floor balcony.

The third-level mezzanine has brick safety walls enclosing the former active lines and 34 kilovolt bus feeders that ran the length of the mezzanine. On the east end of the building were the potential transformers, which measured voltages. Lighting arresters were also located here to protect against lightning strikes on the lines. The lines carrying electricity originally exited the building through holes at the top of the east wall. In the 1990s, the transformers were moved outside as a safety precaution to prevent electrocutions.

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[80] One machine is labeled as being manufactured by The American Tool Works Co. of Cincinnati, Ohio. Machine shops were common in powerhouses so operators could repair equipment as necessary.

[81] Rushmore and Lof, 158, 169; information on the cooling water skid provided by Phil Nieman, MWRD.

1. **Character:**
   The movable dams have been heavily altered since their original construction, but the dam operating house retains its original characteristics. The guide walls and access stairways also remain, although the stairways have been altered.

   The powerhouse contains a variety of equipment and machinery dating to various times in its period of operation, but the overall character of the building is retained through the extant original machinery and finishes.

2. **Condition of Fabric:**
   The concrete of the dams and powerhouse has deteriorated. The guide walls exhibit some areas of heavy spalling while other areas are failing. The exterior of the building has had some repair work done to the concrete. The powerhouse's interior is also suffering some deterioration, particularly the glazed brick, which is falling off the walls. The remaining equipment is in good condition.

B. Construction:
Movable Dams
Little information has been found on the construction of the dams. The concrete used in the lock and dam contained broken stone and limestone screenings. The specifications required that the concrete be wet when poured; specifically, "the mass when disturbed will quake like fresh liver, but must not be so wet that water stands upon the surface."[82]

Powerhouse
Construction of the wheel pits and foundations of the dam and powerhouse required excavation in Joliet limestone riddled with springs and pockets of clay. An *Engineering News* article noted, "In order to prevent the possible blowing out of the clay under the walls in the future, when softened by prolonged exposure, concrete cut-off walls are carried down 15 or 20 ft. into the clay, and where the surface of the clay is exposed it is excavated and covered with a floor of concrete."[83] As a result, the powerhouse sits on a concrete foundation poured on solid rock. The wheel pits were faced with a 36" deep layer of concrete "worked with spades to give a smooth surface finish."[84]

The contractor, Hayes Brothers Construction Company, used a "batch type" mixer invented by J.W. Page to mix concrete on site. A cableway running parallel to the channel delivered the raw material. The mixer consisted of an open pan (drum) measuring 8' in diameter and 4' deep that was placed on a "shaft set at an angle of about 52 degrees with the vertical end driven by spur and bevel gearing from a two-cylinder reversible vertical engine of 20 HP." The raw materials were mixed in 30 cubic foot batches and emptied into dump cars that ran on a track beneath. The concrete mixer and

[82] "Movable Dams and Lock at the Power Plant," 515.
[83] "Power Plant of the Chicago Drainage Canal," 54.
[84] "Power Plant of the Chicago Drainage Canal," 54.

cableway, along with the channelers, drills, and hoist, were powered by steam generated by a central boiler house containing two boilers of 100 horsepower each.[85]

Two grades of concrete were used in the construction of the powerhouse: No. 1 was used in those areas that had to be watertight and consisted of 1 part cement, 2-½ parts sand or limestone screenings, and 4-½ parts broken stone; No. 2 was used for fill and was made up of 1 part cement, 3 parts sand or limestone screenings, and 6 parts broken stone.[86]

Engineering News noted that the powerhouse was "notable in that concrete block construction was adopted for both plain and ornamental work."[87] The light gray concrete, T-shaped blocks used in its construction were based "on the system of the American Hydraulic Stone Co. of Denver, Colorado," while those in the side walls and partitions were hollow. The concrete was a mixture of Portland cement and sand, gravel or broken stone. The exposed block faces were to have "smooth surfaces similar to 'rubbed' faces of ashlar masonry," which would be achieved by using a ¼"-thick masonry facing made from 1 part Portland cement and 2 parts sand. The blocks in the cornices, bases, capitals, windows and doors were "to have sharp, well defined edges" and be anchored in place. The specifications also noted, "where required, the exposed surfaces of the blocks are to be darkened by the use of lamp black." The construction blocks were machine molded, but the ornamental details, voussoirs for the window arches, and the blocks for the lintels, sills, and pilasters were to be tamped by hand. Round steel rods would reinforce the large blocks. The blocks were made on site and tamped on a large concrete floor; "the ordinary blocks taken from the press are placed on racks on drying cars and left under cover for 24 hours, after which they are removed to the curing, or storage yard." The plant could make 800 to 1,100 blocks a day.[88] The use of concrete block in the powerhouse may be somewhat unusual for the time. Generally, early powerhouses were built of structural steel frames and brick or reinforced concrete, but "there were also limited experiments with concrete block and terra-cotta tile cladding over steel frames."[89]

C. Mechanicals:

Movable Dams

The movable dams operated like bear-trap dams in that "pressure due to the head of water under the dam balances both the weight of the dam itself and that of the water flowing over it," keeping the dam in equilibrium.[90] To raise or lower the dam, a system of culverts and valves regulated the flow of water into and out of the dam chamber. In the lowered position, the dams fit into the dam chambers, which were shaped to accommodate the curved surfaces of the dam faces.

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[85] "Power Plant of the Chicago Drainage Canal," 54.
[86] "Power Plant of the Chicago Drainage Canal," 54.
[87] "Power Plant of the Chicago Drainage Canal," 55.
[88] "Power Plant of the Chicago Drainage Canal," 55.
[89] Hay, 105.
[90] "Movable Dams and Lock at the Power Plant," 513.

The concrete block operating house covered three pits (weir tube, indicator and inlet) used to operate the movable dams. The weir tube pit held the weir tubes, which were 26" cylinders hanging from chains that passed over pulleys and connected to counterweights. The weir tubes moved vertically in the pits and were operated by a hand wheel located in the operating house. They controlled the water level in the two dam chambers, either separately or together. The weir tube pit drained via a conduit leading to the tailrace of one of the dams. The conduit was equipped with sluice valves and could draw water out of the chambers if the weir tubes were not functioning. The indicator pit in the operating house allowed the operator to see the position of the dams, the weir tube counterweights, and the level of water in the dam chambers and above the dams via four float-gauge wells of 12" pipe. Finally, the inlet pit was made up three wells, with the outer ones connected to the dam chambers. Sluice gate valves controlled the flow of water into these wells. A conduit screened by a trash rack extended from the central well into the channel above the dam.[91]

The operating house had windows on the east and west walls. Near each window was an indicating gauge, hand wheel for operating the weir tubes, and a model showing the position of the dam which that window overlooked. Additional operating controls were located in the concrete pier separating the two movable dams. The combination of these controls allowed the operator to let water into or out of the dam chamber, which regulated the position of the dam itself.[92]

Powerhouse
In simple terms, powerhouses take the hydraulic "virgin power,…which hydraulic turbines converted into *mechanical* energy, the latter by electric generators is changed into *electric current*, which is finally *transmitted* to the market."[93] A combination of three types of equipment is needed to effect this change of the hydraulic power into electric power: hydraulic (made up of turbines and governors), electricity-generating (exciters, generators and regulating devices), and transmitting (lines).[94]

The Lockport Power House did not have uniform water distribution, instead taking in the maximum rate in the evening and night and a minimum rate in the early morning. The normal operating head was 34', although that could vary from 30' to 38'.[95] Water entered the powerhouse through the turbine chambers where 6,000-hp turbines consisting of six wheels mounted on a 12" horizontal shaft that coupled to a generator. The west four chambers contained Wellman-Seaver-Morgan wheels with 54" Jolly-McCormick runners. The two units to the east of the central exciter units were S. Morgan Smith wheels, and the third was a Wellman-Seaver-Morgan wheel. These seven turbines had an

[91] "Movable Dams and Lock at the Power Plant," 513- 514: "Movable Crest Dams at the Water Power Development," 195.
[92] "Movable Crest Dams at the Water Power Development," 195-196; "Movable Dams and Lock at the Power Plant," 513-514.
[93] von Schon, 254.
[94] von Schon, 362.
[95] Holland, Ackerman & Holland, 2.

"aggregate capacity of…910,000 minute-feet (15,167 second-feet), equivalent to 46,880 effective horse power on the turbine shaft under 34 feet of head and at a 80% efficiency."[96] Lombard oil governors regulated the volume of water passing through the gates to the runner.[97]

The central chamber contained three exciters, two of which were manufactured by Crocker-Wheeler Company and one by Western Electric. The 350-kw exciters were multi-polar and direct current operating with a compound wound generator that ran at 300 revolutions/minute producing 250 volts. Each had shafts with two self-aligning and self-oiling bearings.[98] The exciters produced the direct current for the generators needed to magnetize the field.

Coupled to the turbine shafts were seven 4,000-kw generators manufactured by Crocker-Wheeler Company. The generators were the revolving-field type, 60-cycle, three-phase and operated at 165 revolutions/minute producing 6,600 volts. This type of generator was typically used in the early years of hydro-power development.[99]

The transformers, which stepped up the power produced by the generators to 34,000 volts, were located along the south wall of the main floor. Originally there were twenty-one, 1,333-kw, single-phase, General Electric transformers that were oil-insulated and water-cooled (a few are extant). The transformers were remotely controlled from the second level mezzanine. The transformer banks connected to the main terminal bus bars that ran along the third level mezzanine through double-break oil switches (some of which remain). The lines exited the east end of the building, where lightning arresters were located.[100]

D. Site Information:
The Lockport Power House, Dam and Lock are located near the terminus of the Chicago Sanitary and Ship Canal. The Lockport Power House is located at the west side of the channel, followed by the dams and lock. The structures were located here because of the nearly 40' change in elevation from the upstream portion of the canal, which is basically at the same elevation as Lake Michigan.

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[96] "Water Power Development of the Sanitary District of Chicago," 1777.
[97] "Water Power Development of the Sanitary District of Chicago," 1774.
[98] "Power Plant of the Chicago Drainage Canal," 56.
[99] Hay, 52-53. Hay notes that around 1905, a shift to vertical shafts began. These were the predominant type by1912. Specifications from "Water Power Development of the Sanitary District of Chicago," 1774.
[100] "Water Power Development of the Sanitary District of Chicago," 1778.

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Research was conducted at the Metropolitan Water Reclamation District of Greater Chicago's archives. The engineer's reports have been subpoenaed and were unavailable at the time of the research trip. Additional information about the design and construction of the Lockport Power House and Dam may be in those reports. Additional materials are housed in the powerhouse, and research into those with a focus on the operational history and alterations made to the operating equipment is warranted.